Form Conjugate Stresses in Geometric Continuum Mechanics

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Abstract

In standard continuum mechanics, stress acts on the velocity vector field to produce the vector field corresponding to the flux of power in space. In the general setting of differentiable manifolds of arbitrary dimension and devoid of a Riemannian metric structure, this may be generalized by replacing the velocity field by an (n – 1)-form that represents the flux field. It turns out that in this case, the stress, represented in general by a vector valued form, attains a particularly simple form of a tensor just like the classical case. This result is relevant in the case of a body undergoing volumetric growth. Another situation, in which the velocity field is replaced by a differential form that represent a potential for a field, leads to generalizations of electrodynamics as represented by Maxwell's equations. This means that electrodynamics and its generalizations may be viewed as special cases of geometric continuum mechanics.

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